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Division of Computer Research and Technology

Fiscal Year 1980

Annual Report

Volume I

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Division of Computer Research and Technology

Oct. 1, 1979 through Sept. 30, 1980

Summary

Annual Report

Volume I

Foreword

The work of the Division of Computer Research and Technology covers a large spectrum of activities. It ranges from doing research in biology, statistics, mathematics and computer science to providing computer facilities and services for the NIH.

The several parts of DCRT embody and integrate this variety of talents. Each part has a major functional focus. But the success of the Division's work arises from the interaction of the members of each group with others across organizational and disciplinary lines. Many projects in the Division require the expertise of people from several segments of the spectrum.

DCRT's collaboration links our staff to professionals inside NIH and also outside NIH. The result is a balance in emphasis to provide the work done by DCRT at NIH with the benefits of collaborations outside of NIH. While DCRT does not have money for grants, it does provide occasional support for meetings on scientific topics related to its work.

This year our story starts with the service end of the spectrum and moves to the research end, presented in two volumes:

Volume I gives a summary overview of the work of each group and highlights its accomplishments.

Volume II includes detailed projects and activities of each group.

If you have comments on the report or suggestions for improving future versions, please send them to:

DCRT Information Office
NIH Building 12A, Room 3027
9000 Rockville Pike
Bethesda, Maryland 20205

From the Director

The Division of Computer Research and Technology (DCRT) was established in 1964 to make a then-emerging computer technology useful to NIH biomedical research and administration. Over the years, the work of the Division has indeed become integral to the conduct and management of the NIH research programs. It is a pleasure to report the accomplishments for FY1980 of an exceptionally competent and productive group of DCRT laboratories, branches, and offices and of the people that work in them.

The several complementary functions within DCRT support laboratories and clinics throughout NIH in a wide range of activities, as an essential part of the core of the NIH intramural scientific programs. Our independent biomedical research and technical development keep pace with advances of the times.

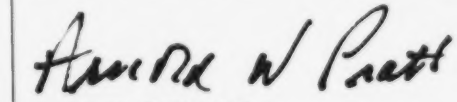
Computer use by NIH scientists and administrative staff has grown from exploration of emerging technology to innovation and leadership in information processing techniques across many fields. Only the combination of talented people and capable machines can cope with the vast amounts and varied types of computing at the NIH.

The essential challenge facing the Division and the NIH is to maintain continuity and to increase sophistication in computing in the face of constant change. Biomedical research is always exploring new fields, developing new investigational techniques. Computer science and technology are also dynamic fields, producing new machines and computer software techniques.

The constraints of the Federal personnel and procurement systems are an additional challenge. During FY80 the DCRT has been fortunate to retain highly skilled, experienced, and dedicated staff in the face of an extremely competitive national labor market in computer scientists and electronic engineers. Hiring appropriate people from this market is often difficult under Federal procedures and shifting personnel ceilings.

The complexity of Federal procurement procedures has in fact delayed getting new, more powerful, less expensive computers for the NIH Computer Center. But hard work by DCRT technical staff and the DCRT Office of ADP Policy Coordination during the past year has made it possible to maintain a responsive level of service on the NIH central computing facilities and has moved the necessary procurements into the forseeable future.

DCRT looks forward with enthusiasm to the coming year as an opportunity to work with NIH scientists and administrators in the creation of still more powerful and civilized computing systems. Equally important is the opportunity to build stronger intellectual links between this technology and the substance of science and the art of administration at NIH. After 16 years the frontiers of computing remain open for new advances in all NIH programs.



Arnold W. Pratt, M.D.

Director

Division of Computer Research
and Technology

Table of Contents

Division of Computer Research and Technology

Computer Center Branch 1

Designs, implements, and operates the NIH Computer Center; provides assistance, training and technical communications to the more than 6,000 users of the Central Utility.

Data Management Branch 7

Serves as a central resource of systems analysis, design, and programming for data processing projects relating to scientific, technical, management, and administrative data.

Computer Systems Laboratory 11

Provides consultation and collaboration in the design and implementation of specialized computer systems for laboratory and clinical applications.

Laboratory of Statistical and Mathematical Methodology 17

Provides statistical and mathematical help in the computer analysis of biomedical data; offers statistical and mathematical packages for users; develops methodology in multivariate analysis, curve fitting, biological shape and pattern theory.

Laboratory of Applied Studies 23

Relates mathematics, statistics, and computer sciences to such biomedical problems as ECG analysis, evaluation of physiological systems in health and disease, modeling of the microcirculation, and estimation problems in laboratory medicine.

Physical Sciences Laboratory 27

Conducts research in mathematical theory and practical instrumentation to explain biological phenomena in terms of chemistry and physics at the subcellular molecular levels.

Office of ADP Policy Coordination 31

Coordinates the complex Federal policies and procedures that govern getting and using computers at NIH.

Office of Administrative Management 33

Provides general administrative management support for the Division's work.

Office of Scientific and Technical Communications 34

Serves as a central source of information about DCRT activities and about computer-related disciplines.

The Computer Center Branch designs, implements, and operates the NIH Central Computer Utility and its associated online telecommunications facilities in support of scientific and administrative programs. Joseph D. Naughton heads this largest component of DCRT.

Computer Center Branch

Joseph D. Naughton, Chief

Functions

The Computer Center Branch designs, implements, and operates the NIH Central Computer Utility and its associated online telecommunications facilities in support of scientific and administrative programs. The nucleus of the Computer Utility consists of two large multi-computer facilities, the IBM System 370 and the DECsystem-10. Communications facilities link these two subsystems and connect them by telephone lines to terminals of various types located in research laboratories and administrative offices throughout NIH.

This computing and communications equipment (systems hardware) is complemented by a complex set of computer programs (systems software), which either are designed and implemented by Center personnel or acquired from other sources and adapted, to meet the unique requirements of the NIH biomedical research program.

Professional, technical, and administrative support personnel provide the many services available at the Computer Utility and ensure the smooth functioning of the total system 24 hours a day, 7 days a week.

Hardware and software aspects of the Computer Utility are maintained and controlled by the 139 members of the Computer Center Branch. The professional staff — 51 computer specialists, programmers, and systems analysts — provides the expertise to design and implement the complex computing systems; they supply extensive training and information services, assist users in problem diagnosis, and maintain and schedule recurring production applications. The 78 technicans operate the computer systems and auxiliary equipment and provide data entry services. The remainder of the staff gives the necessary administrative support.

In addition to operating the Central Computer Utility, the Computer Center Branch provides systems support, programming, consultation, documentation, training, and program support. A variety of programming languages are available, including FORTRAN, COBOL, PL/I, SAIL, and Assembly Language. The Center also maintains a data base/data management system (IMS) and a comprehensive library of utility programs.

A number of interactive systems — such as WYLBUR, TSO, and the timesharing services of the DECsystem-10 — facilitate the creation, submission, and output of jobs and permit direct interactive computing using FORTRAN, BASIC, CPS, APL, MLAB, and other languages. The Center provides several facilities for the output of textual and graphic information on paper and microfiche. Programs to show two- or three-dimensional pictures on cathode ray tube displays and "sketch pads" for advanced graphic projects such as those involving macromolecular structures are also available.

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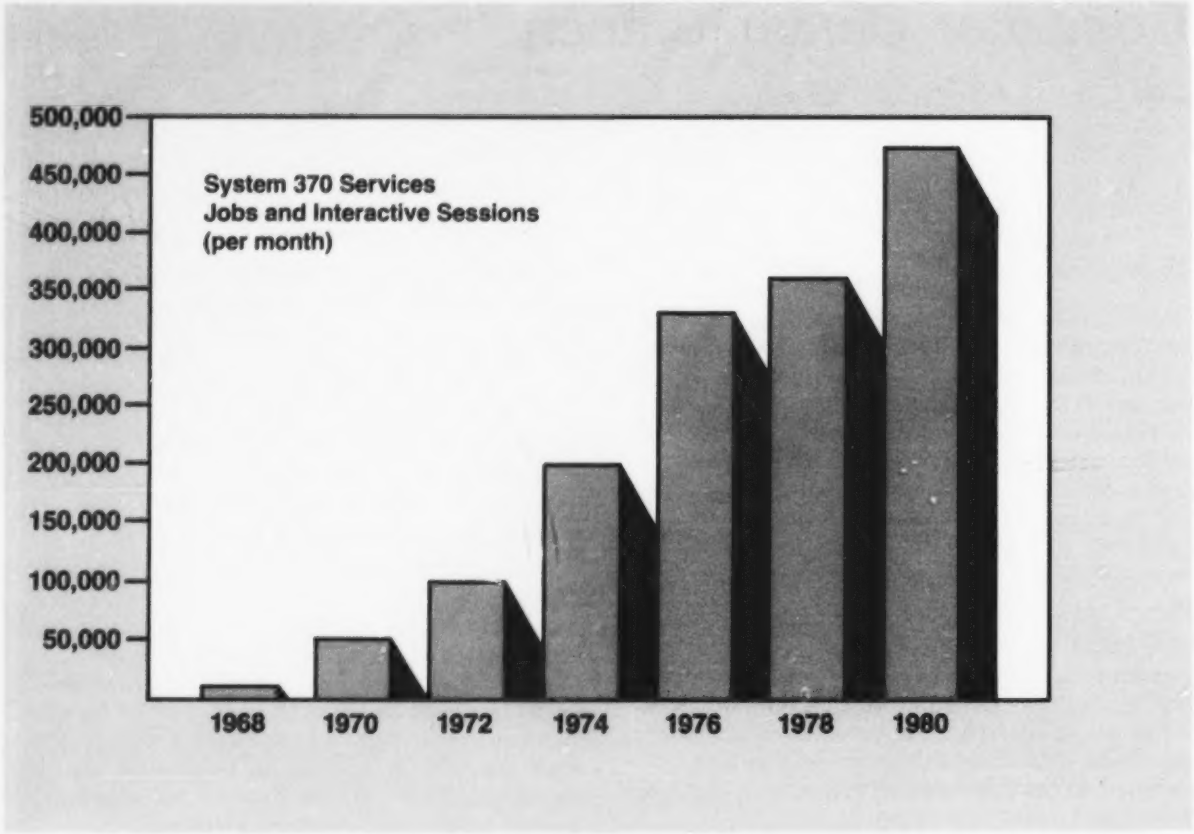
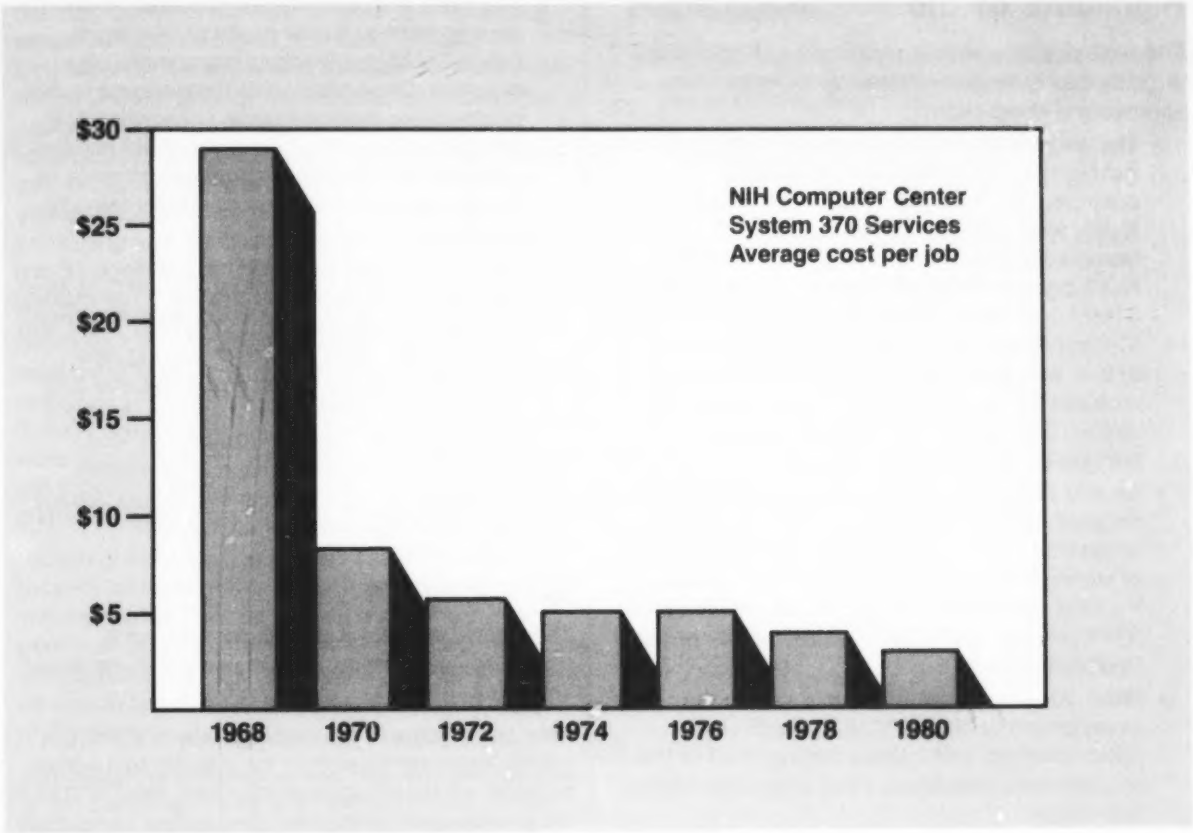


Scope of Work

The NIH Computer Utility provides services to over 6,000 users including research scientists and program managers from every area of NIH as well as users from 24 other Federal agencies, in its role as a Federal Data Processing Center (FDPC) for Biomedical and Statistical Computation. All services are provided on a cost-recovery, fee-for-service basis through the NIH Service and Supply Fund.

Through the years, the workload of the Computer Utility has increased steadily. In FY1980 the Utility processed at least 11,000 mainstream jobs per day, completing 80 per cent of them within one hour. The 1800 remote terminals located throughout the country were the source of an additional 6,000 interactive sessions per day. Use of the IBM System



370 grew more than 11 per cent during the past year; the system reached its peak in April when it processed 481,249 job-sessions.

The DECsystem-10 timesharing facility continued its steady 10 per cent growth rate and reached saturation early in the fiscal year when it was processing over 12,000 sessions per month.

Research continued in the areas of text editing, application utilization of mass storage devices, display of biomedical objects, computer networking, and communications.

Highlights of the Year's Activities

The past year has been a significant one with many projects that have been underway for years approaching completion.

- The long-awaited reprocurement of improved hardware for the Computer Utility made progress. The contract for the new Timesharing facility was awarded; Digital Equipment Corporation delivered a new multi-processor KL10 system as the year came to an end. An interim upgrade — a new, faster 3033 MP CPU (Central Procressing Unit) for the IBM System 370 — was approved and installed. Bids were received for the replacement of the entire IBM System 370 facility, with contract award anticipated by the end of the year.
- An IBM 3850 Mass Storage System (MSS) was installed to meet the growing need for readily accessible, online data storage space. Capable of storing over 2000 billion bytes of data online, the MSS increased both the effectiveness of the NIH Computer Utility and the productivity of the Operations Staff.
- Major advances were made this year in the development of New WYLBUR. Software, documentation, and internal testing of all of the modules was completed. Final integration testing was begun.
- The most significant monitor upgrade since 1974 was tested and installed on the DECsystem-10. The new operating system, called 7.01, increased system efficiency and reliability and provided a few new commands and system programs. In the upgrade most I/O (input/output) handling routines were rewritten completely, unlocking performance potential that was unavailable under the system configuration of the old 6.03 monitor and giving users a dramatic improvement in system capacity and response time.
- The molecular graphics system was used in the development of a new package of images, called TAMS, for teaching macromolecular structure. Dissemination of the package to 500 biochemistry departments in universities and medical schools throughout the world resulted in a heightened interest in computer graphics as a tool for the representation of macromolecular structure.
- Major reconstruction efforts in Buildings 12 and 12A got underway during the year. The building renovation program, initiated several years ago, provides additional space for arriving new equipment, as well as improved security and convenience for users. Innovations include a new, spacious, User Terminal Room and conveniently-located, computer-controlled, locked output boxes which will ensure privacy and faster distribution of user output.

Future Plans

The Center expects a challenging year as it continues its efforts to provide users with improved services.

After many years in the making, New WYLBUR, a greatly improved version of the popular text-editing program will be in full production use. New WYLBUR will provide users with many new editing capabilities and greatly enhanced document formatting, including automatic pagination and generation of headings, footings, tables of contents, and indices. The new system will also offer automatic recovery after line disconnect or system failure, as well as other performance improvements and new features.

With the arrival of the new System 370 equipment expected early next year, the rapid, efficient installation of hardware and software for the system will be a major priority. Implementation of the new equipment and completion of the building reconstruction will be important steps toward the goal of continuing to provide users with the best available tools for biomedical and statistical computing and the finest in turnaround and support.

Work is underway to redesign and improve the Center's printing capabilities while reducing printing overhead and manpower requirements. New equipment is being integrated into the system and older functions are being phased out in order to provide easy-to-use printing facilities that produce work of consistently high quality. The new facilities will provide expanded character sets, user-supplied character sets, and improved forms capabilities.

Providing full utilization of the capabilities of the recently-acquired mass storage system will be an important priority in the coming year. The current goal is an implementation proposal to determine how the capabilities of the mass storage system can best be developed to meet the special needs of the users of the Utility.

Improving the reliability, availability, and performance of the Computer Utility is a continuing goal of the Center. To this end, the coming year will see the extension of service hours and the implementation of a number of system improvements. To enhance teleprocessing services, the telecommunications link between the DECsystem-10 and the System 370 will be strengthened and improved; new features including networking services, teleprocessing diagnostic facilities, automated fault detection, and screen editing capabilities will be implemented for communications based services. Other projects planned for the coming year will provide better support facilities for remote users, improved scientific functions, and simplified data handling and management techniques.

Publications

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J. Emmett Ward heads the Data Management Branch. DMB staff design and create computer-based data management systems that provide practical solutions to the unique mix of administrative, scientific, and management data processing problems encountered at the NIH.

Data Management Branch

J. Emmett Ward, Chief

Functions

The Data Management Branch (DMB) provides advice and assistance to research investigators, program officials and administrators throughout NIH in planning for and obtaining computer data processing services. In this role the branch is a central NIH resource for systems analysis, design, and programming. There are currently 47 permanent full time employees whose disciplines include computer science, mathematics, and statistics.

Scope of Work

DMB staff design and create computer-based data management systems that provide practical solutions to the unique mix of administrative, scientific, and management data processing problems encountered at the NIH. Each new computer system user is provided comprehensive training in all system facilities and functions. In addition DMB staff teach courses about data management and DMB programming tools; they provide advice on data management techniques to NIH programmers; they serve as consultants to the B/I/D's for obtaining and monitoring contracting services for computer systems development; and they create and maintain general purpose, user-oriented programming tools to speed building and improve operation of applications systems.

The DMB comprises six sections. The **Applied Systems Programming** Section (ASPS) and the **Scientific Applications** Section (SAS) provide general computer systems analysis and programming services for all of the BID's. The ASPS supports general data management, and the SAS handles those projects which require scientific data analysis.

The **Data Base Applications** and **Data Base Enhancement and Control** Sections develop and maintain the central administrative data base for NIH materiel and financial management. The **Clinical Support** Section develops and maintains the Clinical Information Utility as a data base for research and patient care in the Clinical Center.

The **Software Support Section** designs and develops or purchases software development tools and programming aids and provides maintenance and training support for these facilities.

FY80 Accomplishments

At the beginning of the fiscal year the Data Management Branch was advised by the NIH Office of Administration that the original agreement to add five people to the administrative data base development team could not be honored due to personnel shortages. This loss alone will extend the estimated development period by about fifteen months, but it was felt that most of the key aspects of materiel and financial management could still be functioning in a data base environment by the end of calendar year 1981.

In December, 1979 and January, 1980 the additional loss of software development and user liaison personnel also slowed progress on the existing data base effort and caused the DMB to reexamine its priorities and to make some organizational and personnel adjustments. The Documentation and Systems Support Section was abolished and its personnel were absorbed by the Applied Systems Programming Section (ASPS). This enabled the Branch to shift two people from the ASPS to the administrative data base effort. Approximately four months were lost due to project reassignments, personnel shifts, and organizational adjustments, but without these changes the data base project would have been in serious jeopardy.

In spite of these setbacks major progress has been made in this key area. Partial payment of line items on an order and generation and control of payment schedules that go to Treasury were implemented in the middle of the fiscal year. A pilot test of delegated procurement entry utilizing teletype-compatible terminals has been started with the Division of Cancer Treatment, NCI and, if successful, should be completed by the end of calendar year 1980. This first important step will eventually permit BID point-of-transaction data entry for all delegated procurement and receiving actions.

Basic purchase agreements and indefinite delivery contracts require monitoring and control to achieve overall fund control. The software development effort for these functions was completed during fiscal year 1980 and is scheduled to be implemented as fiscal year 1981 begins.

The data content of the NIH Clinical Information Utility was broadened to include vital signs, blood bank, radiology, and nuclear medicine in addition to the laboratory test and demographic data. The Data Management Branch is participating in Clinical Center committee meetings concerning reduction in size of the medical record and future plans for computer based support to NIH clinicians. As an initial trial for automating and reducing the size of selected segments of the medical record, a system was developed to produce cumulative laboratory results on a weekly basis.

In addition to this work on central data management facilities, the significance and breadth of DMB's involvement in the NIH mission is depicted by the multiplicity of computer systems it has developed to support individual scientific, administrative, and management projects during the past year. Virtually every BID has benefited from the computational service provided by the DMB. Each of these systems has served a vital segment of the NIH and when viewed as a group represent the DMB's very reason for existence.

In the area of general support the DMB continued to maintain and teach courses on the Inquiry and Reporting System (IRS) and MARK IV; to support NIH use of Chemical Biological Activities (CBAC) and Biosciences Information System (BIOSIS) awareness searches on a biweekly and semimonthly basis, respectively; to consult and assist NIH programmers and contractors, enabling facile use of DCRT computer facilities; and to maintain and distribute the NCI Survival System.

Future Plans

DMB intends not only to continue its primary role as a central NIH resource, but also to improve the facilities that it offers. Such things as voice input and answerback are being examined for their potential in specific applications areas. New capabilities in file and data base management systems are always being reviewed and improvements in existing systems for data retrieval and analysis are planned.

The Clinical Support Section (CSS) will concentrate on integrating the various independent files in the CIU to facilitate data displays, data analysis, and subfile creation. Collaboration with the Clinical Center to automate and thus reduce the size of selected segments of the medical record will continue. The CSS will examine alternative methodologies for providing routine data analysis facilities and will attempt to define other options for non-routine analysis.

The accounts payable, delegated procurement entry and inventory functions should be added to the administrative data base in the next fiscal year. In addition, design of the requisitioning and general ledger modules should be completed by mid-FY81, and DMB will be actively involved in specifying and developing these two functions by fiscal year end.

Publications

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McKinney, R. W., Pelham, V. F., Hellman, A.: Medical Surveillance Program of the National Cancer Institute. *Proceedings of 3rd Annual Symposium on Computer Applications in Medical Care* . IEEE, 1979.

Van Hoff, D. D., Layard, M. W., Basa, P., Davis, H. L., Jr., Van Hoff, A. L., Rozencweig, C., Muggia, F. B.: Risk Factors for Doxorubicin-induced Congestive Heart Failure. *Annals of Internal Medicine* , Volume 91, No. 5, November 1979.

Part of the work of the Computer Systems Laboratory centers on the investigation of applications of microprocessor technology to laboratory data acquisition and control and to the development of new biomedical and clinical instrumentation. CSL (left to right) electronics engineer Ronald Fico discusses one such project with Section Heads Arthur R. Schultz, Jr. and Daniel Syed.

Computer Systems Laboratory

Alan M. Demmerle, Chief

Function and Scope of Work

The Computer Systems Laboratory, a group of about 30 professionals representing the disciplines of engineering, computer science, medicine, and chemistry, is the major source of expertise at NIH for minicomputer and microcomputer technology. CSL engineers and scientists, in collaboration with NIH laboratory and clinical investigators, apply this technology in the areas of laboratory automation and patient care. Most work supports intramural research programs, although some projects have been undertaken with extramural programs and, more rarely, with other Federal agencies. In addition to supporting ongoing research, CSL also investigates new applications of computers to biomedical research and identifies appropriate technology for use in these applications.

Small computers that can be used in the laboratory or at the patient's bedside are increasingly important to biomedical and clinical research because of more and more complex research methods and instrumentation. Laboratory automation, data acquisition from analytical instruments, and patient monitoring are examples of functions to which CSL has applied small computers at NIH. Computers may be used only in an adjunctive manner, for example, as a more convenient means to acquire laboratory data; or they may be integral parts of an elaborate instrumentation system such as a computer-controlled mass spectrometer.

Recent technological advances are contributing to changes in the nature of CSL's work. Foremost among these advances are developments in large scale circuit integration (LSI)—the microprocessor revolution—that have brought about the miniaturization of computer components and a dramatic decline in their prices and power requirements. One result has been a greater availability of computers for biomedical research. Thus, CSL engineers are now able to use microprocessors to solve problems that once were avoided because of cost, size, or manpower constraints.

The Laboratory brings together professionals with diverse backgrounds to apply computer technology effectively to NIH programs and to offer research and development capabilities responsive to NIH needs. Engineers, computer scientists, and mathematicians evaluate and apply new electronics and computer technology to solve biomedical problems. Personnel with backgrounds in medicine, biology, and chemistry communicate effectively with biomedical investigators and clinicians and identify potential computer applications. This multidisciplinary approach aids the recognition of problem areas that will benefit from automation and the interpretation of research needs in terms of computer methods.

This year, CSL engineers and scientists worked on approximately 26 projects, representing coliaboration with almost all of the Institutes. Most of these projects were continued from previous years; seven projects were begun this year. Projects range in size from consulting activities of a few days or weeks duration to large scale efforts taking a number of man-years. Because much work involves the development of new methods or technology, or is influenced strongly by the changing needs of research, it is often difficult to predict the long term scope of a project.

FY80 Highlights

Most CSL projects begin in direct support of NIH research programs and involve collaboration with investigators from one or more Institutes or Divisions. A case in point is a project between the Biomedical Engineering and Instrumentation Branch of the Division of Research Services and CSL to develop an automated electron microanalysis facility for elemental analysis of biological specimens. Started in FY79, this project received funding from several Institutes for capital equipment purchases. Investigators from the sponsoring organizations and from several other Institutes are planning research projects that will use the facility.

The system includes a 200 key scanning transmission electron microscope, a 50 key electron microprobe, and a PDP-11 minicomputer. The facility will be equipped to perform electron energy loss spectrometry and both energy and wavelength dispersive x-ray spectrometry. The computer will monitor, display, and store experimental parameters to facilitate repeating an experiment. Furthermore, it will perform online acquisition and analysis of data signals from the two microscopes. The signals include the outputs of the several spectrometer attachments as well as various electron current signals which result when the electron beam strikes the specimen. Each signal contains information relating to the elemental composition of the specimen.

Projects that are characterized by the need to handle numerous signals, large quantities of data, timesharing of several simultaneous tasks on one computer, or particularly complex signal processing often take several years from inception to completion. For example, the electron microanalysis project required that literally dozens of signals be interfaced to the computer. Interfacing hardware had to be purchased, input/output drivers had to be designed and written, and system software had to be developed to acquire and process each signal. All of this work must be coordinated with the preparation of application software to implement specific experiments.

By contrast, when goals are more limited, projects can often be completed in a few weeks to a few months. Microprocessors are used to advantage for these smaller projects to accomplish objectives that were once precluded because minicomputers were too costly or special purpose instrumentation was unduly complex. This year, a microprocessor system was developed for the Laboratory of Kidney and Electrolyte Metabolism of the National Heart, Lung, and Blood Institute to facilitate experiments to determine the transepithelial resistance of in vitro kidney tubule preparations. The determinations are made by passing electric currents through the preparation and measuring the resulting voltages at each end of the tubule. Previously, a pulse generator was used to initiate a current pulse of fixed intensity and duration, and a storage oscilloscope recorded the voltages. Measurements must be made under steady state conditions, so the investigator had to estimate the proper pulse duration to achieve the steady state. Since voltages are needed for a number of current values, the measurement procedure was tedious, time consuming, and prone to error.

The new microprocessor controller lets the user specify a series of current values of various intensities. It then applies each current in turn, determines the time at which the preparation's response has reached the steady state, records the response, and removes the stimulus. After cycling through all specified currents, it prints a table of measured voltages on a teleprinter. The complete set of measurements takes only a few moments, and can easily be repeated to verify results.

In addition to supporting research programs in other parts of NIH, CSL engineers and scientists often initiate research and development programs of general interest to the biomedical community. B/I/D programs are then served by these developments.

There has been considerable interest in CSL in applying modern software engineering principles to computer communications and network architecture. Other work centers on the investigation of applications of microprocessor technology to laboratory data acquisition and control and to the development of new biomedical and clinical instrumentation. One fine example of spin-off from this kind of work is the Distributed Laboratory Data Acquisition and Control System project in conjunction with the National Institute of Arthritis, Metabolism, and Digestive Diseases. The system consists of a network of microcomputers connected by way of a communications processor to a central data processing computer. Each remote microcomputer handles the realtime data acquisition requirements and provides instrument control functions for a single instrument or laboratory. The collected data is transmitted, at a convenient time, to the communications processor using a data communications protocol that ensures error free transmission. The communications processor serves as a store and forward front-end to the central computer. An important feature is that the user needs only minimal knowledge of the communications process. A simple command entered at the remote microcomputer is all that is required to transfer a data file. All details of the transfer are handled by the network.

Good R & D programs require good tools. For many years, CSL has had an electronics laboratory. More recently, a computer laboratory has been added. The computer laboratory facilities include "development systems"—minicomputer and microcomputer systems—that are used to investigate and implement new software and hardware for eventual use in target computer systems, i.e., systems intended for use in specific projects. These development systems let work begin on a project long before the target system ordered for that project is delivered, thus improving productivity and reducing the time until project completion. This year, the computer lab facilities were expanded so that more people can use the development systems at the same time. Virtually all minicomputer and microcomputer development work can now be done using development systems.

Development systems are indispensable to microprocessor projects since software development work is often not possible on the microprocessor hardware itself. As microprocessors become faster and more powerful, they are being used more and more as low cost substitutes for minicomputers and in situations that used to require special purpose hardware: data acquisition systems, interfaces between instruments and computers, and programmable instrument controllers. As a result, the importance of the computer lab has increased markedly.

The Laboratory is called upon for consultative assistance in its areas of expertise by both the intramural and extramural programs. Usually such assistance is limited to providing expert advice—the conventional definition of consulting. Occasionally, however, a consulting role may lead to engineering or software work, or even to a full-fledged project. Last year, CSL did a study for the NIH Library to determine the potential uses, costs, and benefits of computers for automating library functions such as circulation, cataloging, and ordering. This led, this year, to the preparation of an RFP for a library computer system. CSL involvement in the procurement and implementation of a library system is expected during the coming year.

CSL continued its support of the annual international conference, Computers in Cardiology. The conference provides a forum for direct interaction and exchange among physicians, computer scientists, and engineers who are using computers to assist research or clinical care in the field of cardiology. CSL's part in the 1980 conference is greater than in past years. Because DCRT is the host organization this year, CSL is planning and organizing the conference, to be held at Williamsburg, Virginia on October 22-24, 1980.

Future Plans/Trends

The outlook for FY81 and beyond is affected by several sets of circumstances. Economic and technical developments in large scale circuit integration are increasing the number of useful and affordable minicomputer and microcomputer applications to biomedical research. Furthermore, many of the functions CSL engineers once performed by designing special hardware are now done with microprocessors. As a result, an increasing amount of effort now goes to the development of software and firmware. To remain highly responsive to NIH's research needs in the face of continuing personnel retrenchment, contracts for software services are being established. A basic ordering mechanism for these services should be in place during FY81. Then the many well-defined software tasks that arise from month to month can be easily ordered and obtained in a timely fashion.

The manufacturers of computer hardware, by using technological advances, are able to provide far more sophisticated central processors at much lower cost/performance ratios than in the past. This new breed of computer greatly increases the scope of work that CSL can undertake. The general area of image display and processing is a good example. A few years ago, image work (because of the huge number of data points that make up even a modest picture) was limited to very large and expensive installations. Today, CSL is able to set up the tools for image analysis by employing computers that would have been completely out of reach just a short time ago. CSL engineers and scientists are in fact now planning for an image processing facility including a virtual memory computer and several high quality displays. This facility will be installed for use by scientists from throughout the NIH community whose work can be aided by image analysis techniques.

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Sharrow, S., Thomas, C., Levy, I., Powell, J., Chused, T.: Analysis of Two Color Fluorescence Using Dual Lasers. Cell Sorter and Flow Cytometry Meeting, October 21-23, 1979, Annapolis, MD.

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Fiscal year 1980 was the Laboratory of Statistical and Mathematical Methodology's sixth year as a separate entity within DCRT. Looking over LSM's expanding volume of computational and consultative service are James E. Mosimann, LSM Chief, and George A. Hutchinson, Biomathematics and Computer Science Section Head.

Laboratory of Statistical and Mathematical Methodology

James E. Mosimann, Chief

Function

The Laboratory of Statistical and Mathematical Methodology (LSM) combines research in mathematical statistics, mathematics, computer, and information science with collaboration and service in these areas to NIH researchers and administrators.

In addition to the position of the chief, the laboratory has fifteen full-time professional positions distributed among four sections:

- The **Statistical Software Section** (SSS) provides consultation to and collaboration with NIH researchers and administrators in all computational aspects of biomedical data analysis, including selection and support of large program packages. Three specialists in scientific programming are led by a computer systems analyst whose specialty is statistics.
- The **Biomathematics and Computer Science Section**(BCS), directed by a mathematician, performs independent research and provides consultation and collaboration in the specialities of its five computer and mathematical scientists.
- The **Statistical Methodology Section**(SMS) works closely with the Statistical Software Section. Three professionals in mathematical statistics provide biostatistical consultation and do independent research.
- The **Medical Information Science Section**(MIS) investigates and develops methods for application of information and computer science to medical language data processing. Two computer specialists work under the direction of a computer systems analyst who is an expert in computational linguistics.

Scope of Work

LSM staff interact with all NIH institutes, with other Federal agencies outside HHS, and with biomedical researchers worldwide. FY 80 was LSM's sixth year as a separate entity within DCRT. The volume of its computational and consultative services continued to expand; its research activities maintained about the same level as the preceding year.

A major part of LSM activity is the offering of statistical and mathematical program packages to the NIH user community. LSM accepts responsibility for evaluation of new program packages and their suitability for NIH. When it offers a package to the NIH community, LSM makes three basic commitments:

1. Maintenance of the package, with adequate documentation, through NIH computer system changes, package updates, and corrections.
2. Rapid response to queries concerning user access to a package program, including job control language and program parameters.
3. Assistance in interpretation of results.

During this year, as in the past year, the Statistical Software Section of LSM maintained the following program packages and programs on the IBM 370 system of the DCRT Computer Center:

BMD, BMDP, Biomedical Computer Programs, UCLA

SPSS, Statistical Package for the Social Sciences, SPSS, Inc.

SAS, Statistical Analysis System, SAS Institute,Inc.

P-STAT Statistical Package, P-STAT, Inc.

IMSL, International Mathematical and Statistical Libraries, IMSL, Inc.

MSTAT1, Collection of Mathematical and Statistical Programs, DCRT

There is a major committment to maintain these packages and respond to queries about their use. During this year every package went through at least one major update. During FY 80 alone the SSS staff responded to over 4,000 calls.

The Biomathematics and Computer Science Section maintains several program packages and specialized systems on the DEC-10 system of the Computer Center. Foremost in use is the interpretive program

MLAB, designed (by LSM scientists) for biomathematical modeling. Another LSM staff member has written and maintains C-LAB, a collection of programs for pattern recognition and clustering. BCS supports the PROLOG system (for non-numerical data processing) and REDUCE, an algebraic manipulation language. BCS also supports a DEC-10 version of IMSL whose S/370 version is supported by SSS. The Unified Generator Package, written and maintained by a BCS staff member, is on DCRT's System 370.

As a result of LSM's policy of not only supporting the use of these program packages but also aiding in the interpretation of their output, the statisticians of the Statistical Methodology Section provide consultation over a wide range of scientific fields. Some very brief consultations are very successful because there is a known answer to the question at hand. Other consultations involve extensive time and statistical/mathematical/computer science research as well.

Research projects in LSM vary widely from studies of natural language processing for medical information systems and studies of efficient algorithms for information retrieval to studies in mathematics and statistical methodologies for biomedical applications.

Highlights of the Year's Activities

Computation

In FY 80 LSM put a special effort into instruction on, and documentation of, program packages. The SSS staff taught a total of eight courses on the SAS package. Extensive documentation was prepared for MLAB, which was used by several hundred NIH researchers in FY 80. A new *Beginner's Guide to MLAB* and a revised *MLAB Reference Manual (Ninth Edition)* were distributed. A series of tutorial articles on MLAB in *Interface* was begun; four articles have appeared to date. The DCRT course in MLAB was divided into two levels, beginner and advanced. MLAB was enhanced by technical improvements, which increase speed of computation and reduce memory requirements. New graphics linetypes for contour maps and a new matrix operation were added.

LSM activity was significantly affected by the increased use of statistical packages, which was almost doubled in FY 80. The average accesses per month of the SSS statistical packages alone rose from 12,000 during FY 79 to 23,000 in FY 80. Package use over the past five years is shown in Figure 1.

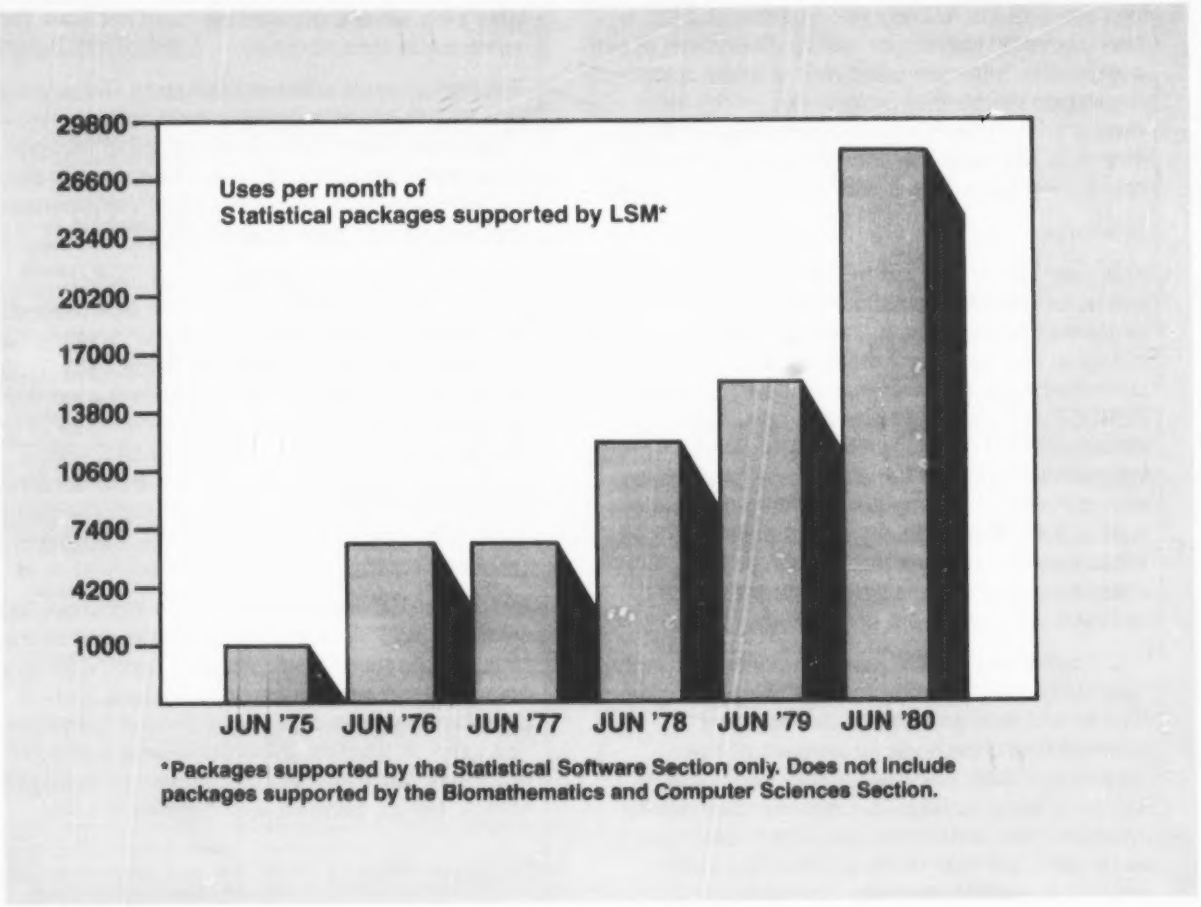
Consultation

The pattern of LSM consultation in FY 80 was similar to that of the previous year. Most consultations (55 per cent) involved statistical advice combined with considerable computer use. Others (40 per cent) involved computer use alone, and a small fraction (5 per cent) involved mathematical or statistical advice with only limited computer use. The following examples illustrate the great variety in both the nature of and the time required by LSM consultations.

For several years LSM has worked with Drs. Wineman, Hirschman, and Wolfson of NIAMDD on a study of reasons for hospitalization of patients with end stage renal disease on maintenance hemodialysis. Multiway table analyses were used. A method was devised for the analysis of hospitalization rates when patients are observed for varying lengths of time. The final paper was prepared this year.

Another collaboration, with Drs. H. Hoffman, DRS, and R. Webber, NIDR, involves research in mathematical and statistical methods, as well as in the biomedicl fields concerned. Variation in the shape of the mandibles among genetically different strains of laboratory mice is being studied to help control genetic purity of the strains. This uses symmetric axis geometry as well as multivariate size and shape analysis, both the subject of research by LSM members. Special computer programs have been prepared for this ongoing study.

A consultation with L. Geiger, DRG, required considerable effort but no new research in computer



science or mathematics. The Unified Generator Package, supported by LSM, was used extensively to make inverted files or indexes from three files: the IMPAC file on NIH grants, contracts, and intramural research; the NIH Clinical Trials file; and the expertise field of the CMIS file (Committee Member Information System). The new indexes permit searches based on Boolean combinations of terms occurring in the text. Such searches are quick and of minimal cost. The Unified Generator Package created both the software for generating the indexes and the software for subsequent searches.

As an example of a long-term effort which involved statistical analysis but no new research in statistics, LSM collaborated on two studies with A. Tahmoush, NINCDS. The first study of physiological measurements in patients with Causalgia (a pain syndrome), employed both multivariable parametric and nonparametric methods, as well as extensive computations and data reduction. The second study involved one of the instruments used in studying

Causalgia. This instrument uses backscattered light to permit noninvasive measurements of blood flowing through an artery. An in vitro system is being used to study effects of changing pressure and flow in the instrument's readings. This study also involves several variables and considerable computer analysis using SAS, BMDP, and SPSS.

A typical statistical consultation that involved intensive effort over a short period of time took place with M. Daniel, NHLBI, studying synapses in chick retinas. It required knowledge of small sample

properties of the Kolmogoroff-Smirnov statistic, a nonparametric statistic for testing differences in two populations. Intensive effort over a single week developed the needed probabilities, which were computed using only small modifications of SPSS output. In this case the nonparametric tests gave results consistent with a prior biological hypothesis.

Research

This year research in the BCS included projects in computer science, biomathematics, and general mathematical methods. In computer science, studies of logical and heuristical methods continued for non-numerical data processing using the PROLOG and REDUCE computer languages. A computer classification of medical words pertaining to inflammation and and certain surgical procedures was completed. A computer algorithm capable of making syllogistic deductions from pairs of English sentences was constructed; algorithms for interpretation of paragraphs of straightforward technical information are under study.

In biomathematics, BCS research continued on the "symmetric axis" method for describing biological shapes and their growth and development. Symmetric axis methods for analysis of three-dimensional data, such as for data generated by scanners, were developed. Currently, methods for symmetric axis analysis of gray-scale data, as well as for spherical data (such as observed during embryonic growth) are under development. A collaborative study of human mandible development was completed and is being extended to other primates.

A collaborative project involving analysis of enzyme data from the blood serum of normal subjects and cancer patients was completed. The BCS investigator developed a method of transforming the data into multivariate data points suitable for cluster analysis using C-LAB.

In SMS, research on simultaneous statistical inference was continued. New results were obtained on ratios of means in multivariate normal populations where the several populations need not have the same covariance structure.

Through contract with the Biometrics Unit at Cornell University, SMS is supporting study of the interpretation and utility of the output of variance component routines in a variety of current statistical package programs. Performance of the programs with unbalanced data is under study.

In the Medical Information Science Section, collaboration was renewed with the NCI Laboratory of Pathology, which plans to encode its entire corpus of surgical pathology diagnoses since 1953. Lexical studies and revisions, both for retrieval accuracy and linguistic completeness, were accomplished in collaboration with Dr. D. Henson of NCI. MIS participated in the design of a data base for the Laboratory of Pathology which will become part of the DCRT Clinical Information Utility, a research data base tool for the NIH Clinical Center.

In addition MIS constructed a stem dictionary for the "viral hepatitis" knowledge base produced by the National Library of Medicine. Also, work was done on automated morphosemantic analysis and paraphrasing of medical terms derived from Greek and Latin. In addition, an experimental comparative study was made of medical compounds in English, French, Italian, Spanish, and German.

Future Plans

No major shift in laboratory service or research is anticipated in the coming year. Current levels of statistical and mathmatical program packages support, consultation, and user assistance will be maintained. Research projects will be continuations of those already initiated and reported here.

Publications

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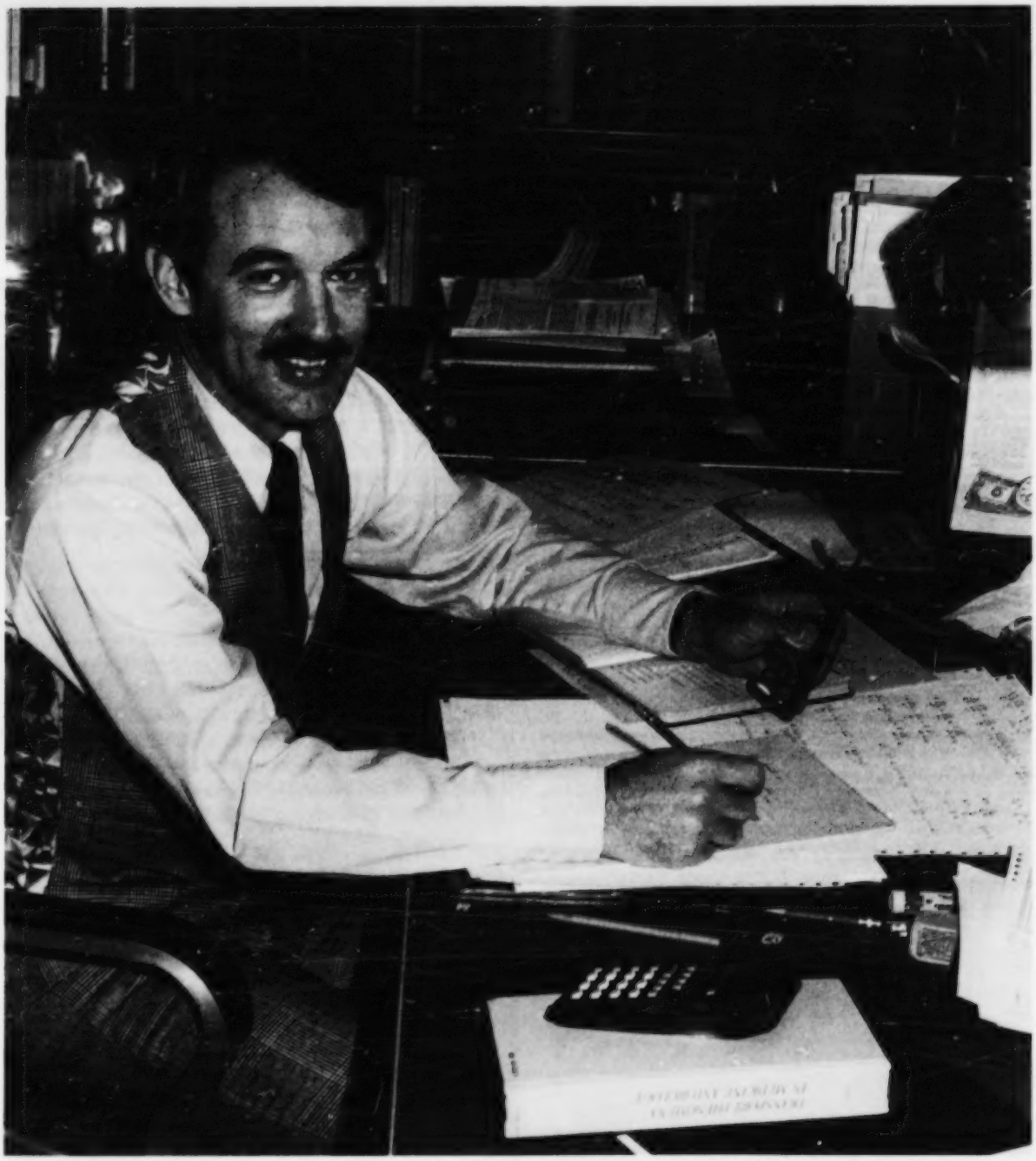

John E. Fletcher, heads the Applied Mathematics Section of the Laboratory of Applied Studies. He is also the Chairman of the Mathematics Department, Foundation for Advanced Education in the Sciences.

Laboratory of Applied Studies

Eugene K. Harris, Chief

Functions

The Laboratory of Applied Studies (LAS) has three main purposes:

1. in collaboration with biomedical scientists, to apply mathematical theory and computing science to the construction, testing, and improvement of mathematical models of physiological processes—particularly reaction-diffusion processes, transport of substrate to tissues, and models of receptor-ligand binding kinetics;
2. in collaboration with clinicians, to develop and apply mathematical or statistical theory and computer programming to improve diagnosis of disease and assessment of treatment;
3. to engage in independent research in applied mathematics, statistics, and computer systems necessary to provide a sound theoretical basis for collaborative studies, and to insure that state-of-the-art mathematical and computational methods are available as research tools at the NIH.

Two sections carry out these primary LAS functions:

Applied Mathematics Section (John E. Fletcher, Ph.D., Chief). This staff of six includes specialists in applied mathematics, computer science, biomathematics, and medicine.

Medical Applications Section (James J. Bailey, M.D., Chief). This six-member staff includes physician-scientists, electronics engineers, and computer systems analysts.

The Chief, LAS, is a biostatistician.

Scope of Work

The Laboratory of Applied Studies works on projects in basic and clinical biomedical science. Largely, these involve collaboration with other groups at NIH, elsewhere in the U.S.A., and abroad. The collaborating investigators this year included:

- *biochemists and pharmacologists* - at the University of Iowa, Medical College of Virginia, and other universities in the U.S.A. and in France—working on models for receptors of drugs or other ligands and on the kinetics of enzymes in membranes
- *physiologists and chemical engineers*—in the U.S.A, United Kingdom, Scandinavia, and Germany—studying the transport of substrate within the microcirculation
- *clinicians*—at NIH—in the cardiology, pulmonary, and hematology branches of the NHLBI; in the arthritis and rheumatism branch of the NIAMDD; and in the medical intensive care unit and the departments of diagnostic radiology and diagnostic imaging of the Clinical Center
- *clinical chemists and pathologists*—at NIH (Clinical Pathology Department, Clinical Center) and elsewhere in the U.S.A., in Europe, and in Japan—engaged in the collection and study of reference values in laboratory medicine
- *electrocardiologists and biomedical engineers*—in the U.S.A., Canada, and Europe—concerned with improved algorithms for computer-based interpretation of ECG's.

During FY80 LAS staff members participated in various teaching and consulting, or advisory, activities. J. Fletcher continues to serve as Chairman of the Mathematics Department, Foundation for Advanced Education in the Sciences.

J. Bailey continues as a member of an NHLBI site-visiting team concerned with computer analysis of exercise ECG's. He also serves as consultant on common standards for quantitative electrocardiography for an EEC-sponsored program in medical and public health.

E. Harris continues to be a consultant in applied statistics to the Food and Drug Administration's Division of Medical Devices and Diagnostic Products. Dr. Harris also serves as consultant statistician to the College of American Pathologists and to the International Federation of Clinical Chemistry (Expert Panel on the Theory of Reference Values), and is a member of the Board of Editors of *Clinical Chemistry*.

Highlights of Year's Activities

Major accomplishments during this year are in the highly technical areas of developing and implementing various computer systems for support of LAS collaborative research projects. Some examples are:

- An interactive software package called PICTUR has been developed by M. Douglas of the Medical Applications Section for use on the DeAnza image processing system. It offers the user many options for analysis of scintillation, ultrasound, and electron-microscopy images, in color and grey levels.
- A computational tool called SPICE (Simulation Program for Integrated Circuit Electronics) has been implemented on the NIH DEC-10 system by B. Bunow of the Applied Mathematics Section, to provide a means of simulating a network of thermodynamic changes. When coupled with another computing system (NET-2) now being installed by Dr. Bunow, a powerful support system will be available to simulate and study the flow of reactive materials through membranes and within cells.
- A set of programs for the NIH 370 computer system has been developed by M. Horton (Medical Applications Section), G. Shakarji (DMB), and D. VanSant (LSM) for study of simulated and real clinical laboratory data using multivariate time series models. These programs will permit research on the sensitivity and specificity of such models in detecting sudden changes or trends in clinical measurements of patients under long-term monitoring.
- The use of the LAS MAC-16 computing system has been greatly facilitated by E. Pottala and A. Mitz (Medical Applications Section). They developed and installed an operating system which provides easy access to compilers and major programs and automatically allocates system resources during execution of user programs.

Future Plans

The promising studies in computer-based pulmonary pathophysiology, initiated by Dr. T. Stibolt (who has left to complete his residency in internal medicine after 3 years of excellent, devoted work in LAS) will be continued by his successor, Dr. R. Burgess. Within time and personnel constraints, it is planned that the application of scintigraphic techniques to the diagnosis and monitoring of renal hypertension will also proceed through additional studies in dogs to eventual use in patients.

Continued progress is expected in all other active projects as well, including:

— development of specialized mathematical methods for representing the microcirculation of perfused organs,

—application of the DeAnza image processing system and other computing systems to cooperative studies with Institute/Division scientists interested in the distribution of various proteins and inorganic ions within cells,

—further development of mathematical methods and numerical algorithms for the solution of partial differential and other nonlinear equations, and

—comparative study of multivariate and univariate models in the analysis of biochemical time series.

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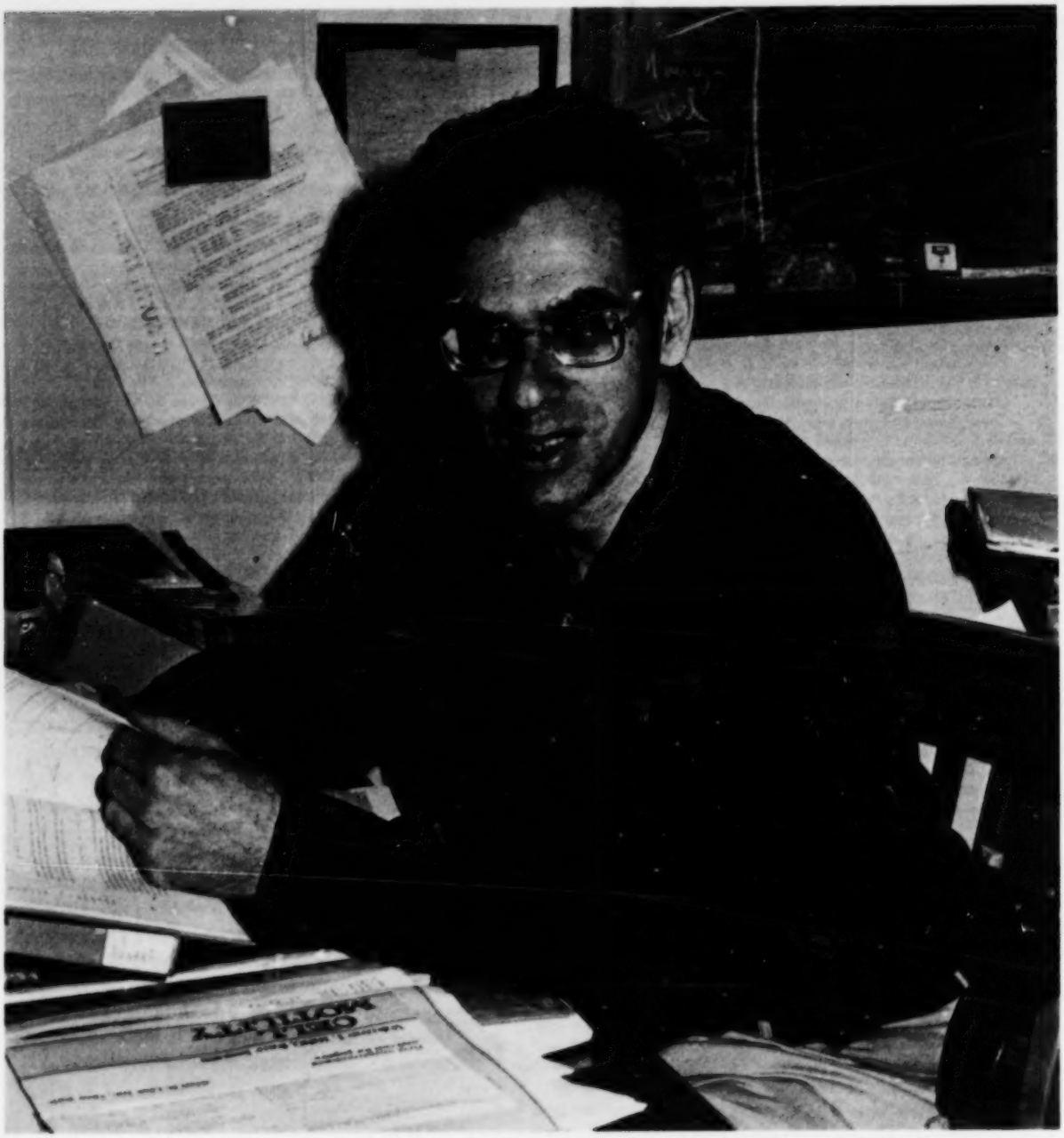

In his work with laser light scattering, PSL Physicist Ralph Nossal performs studies in order to understand how laser Doppler techniques can be used to measure capillary blood flow in tissues.

Physical Sciences Laboratory

George H. Weiss, Chief

Function

The Physical Sciences Laboratory has three principal functions:

- *to carry out research* in the physical sciences in order to understand biological phenomena in terms of physics and chemistry
- *to develop theory and practical instrumentation* for biomedical experiments, and in particular to relate these to the capabilities of modern computer technology
- *to provide consulting services* to other scientists at NIH in physics, theoretical chemistry, and several fields in applied mathematics.

The staff of the Physical Sciences Laboratory consists of six professionals who work in the areas of general biophysics, nuclear magnetic resonance, applications of light scattering techniques in biomedical experiments, the physical chemistry of polyelectrolytes, and problems in applied mathematics.

Scope of Work

The Physical Sciences Laboratory has a combined program of research projects internal to the laboratory and collaborative projects with scientists at NIH and at other institutions. The collaborative projects, done jointly with approximately twenty five other investigators, include two major projects with data being generated by off-campus scientists.

Highlights of the Year's Activities

Although the PSL has devoted most of its past efforts to research in the physical sciences relevant to NIH's mission, this year has seen a contribution that could speed the publication of articles in scientific journals and lead to considerable financial savings to NIH and to other research establishments. Dr. Adrian Parsegian has shown that it is feasible to interface most word processing machines with a typesetting computer—allowing, in effect, an author to typeset his own article. The advantages of this system are that it minimizes typesetting errors and reduces printing costs considerably because much of the printer's labor is eliminated. Preliminary tests of this method have been made on articles for the *Biophysical Journal* and for a book published for a meeting on proteins and nucleoproteins. The results of this experience indicate that a savings in cost of at least 50 percent is possible. Programming is in progress to create the software needed as an interface between word processors and other typesetting computers.

A new 360 MHz NMR spectrometer was purchased and installed in a cooperative project with NHLBI and NIMH. Dr. James Ferretti has spent a considerable amount of time in helping to overcome troubles in the new instrument. Preliminary experiments with the spectrometer indicate that two-dimensional Fourier transform spectroscopy is feasible, allowing a considerable enhancement in resolution of fine structure. This possibility has allowed Dr. Ferretti to resolve resonances in the protein spectrum of bleomycin that have never been resolved with other methods and instrumentation. Further research on the conformation of bleomycin and its interaction with Fe-57 is in progress.

Dr. Nossal has developed a theory for the diffusion of laser light in tissue microvasculature. The theory allows one to relate changes in the spectrum of scattered light to changes in blood volume. The theory has been verified by measurements of particle flow through model tissues by Dr. R. Bonner, BEIB. Such a theory is necessary for the development of a laser Doppler instrument to measure peripheral blood flow.

Dr. Parsegian has continued his investigation into the nature and measurement of intermolecular forces in phospholipid bilayer membranes with the collaboration of Professor R. P. Rand of Brock University. They have been systematically determining the forces operating at distances of 30

Angstroms or less and have shown that the dominant force between membranes that are stable in water is due to the work of removing water between the approaching surfaces. Electrostatic interactions between charged bilayers with adsorbed ions have also been measured, leading to a possible understanding of the activity of enzymes that modify these groups and reside on the bilayer surfaces of naturally occurring residues. The techniques developed by Drs. Parsegian and Rand are now also being applied to the measurement of protein interactions.

Future Plans

All of the projects just mentioned are in progress and will continue into the following year and beyond.

The typesetting project will be extended by creating software interfaces between WYLBUR files and printers' typesetting computers for journals that are popular with NIH authors, and by negotiating with journal publishers for the implementation of these techniques.

NMR investigations on the conformation of angiotensin, bleomycin, and bradykinin will be extended. Future measurements on bleomycin will be undertaken to assign those nitrogen atoms in the bleomycin complex that are ligated to iron molecules. This investigation is expected to shed light on the mechanism of action of bleomycin.

The laser light scattering project will be extended to develop further clinical applications of related optical techniques.

A collaborative project on quantitative aspects of audiometry will probably receive more attention in the coming year. A start was made on this project last year, by manually digitizing a large number of tympanograms. However, digitization done this way was unreliable. This year instrumentation was ordered so that the tympanograms could be produced directly in digital form. When this instrumentation is in place, a study will begin to establish baseline values on normals for parameters of interest.

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The Office of the Director complements the work of the six laboratories and branches of DCRT. Key staff members include (left to right): L. Lee Manuel, Executive Officer; Frances F. Sarles, Secretary to the Director; Dr. Arnold W. Pratt, Director; Dr. William C. Mohler, Associate Director; and Henry J. Juenemann, Assistant Director.

The three DCRT Offices complement the work of the six Laboratories and Branches by:

- coordinating the complex Federal policies and procedures that govern getting and using computers at NIH.
- providing general administrative management support for the Division's work.
- serving as a central source of information about the DCRT activities and about computer related disciplines.

Office of ADP Policy Coordination

Henry J. Juenemann, Chief

Functions

The Office of ADP Policy Coordination, under the direction of the Assistant Director of the Division, has two closely related functions.

1. It serves as a focus for NIH-wide coordination of automatic data processing policy matters.
2. It serves as a central NIH point of contact with the Public Health Service, the Department of Health and Human Services, other HHS Agencies, The General Service Administration, and the Office of Management and Budget on policy questions and NIH's participation in policy development.

The Office also provides advice and assistance concerning internal DCRT operations and coordinates DCRT's ADP policies and activities with those of other agencies.

Scope

The role of the office includes: advising the Director of DCRT and through him the Director of NIH on ADP policy matters; assisting the NIH Division of Management Policy on questions relating to its responsibility for administrative and management computer applications; reviewing and evaluating proposals from NIH B/I/D's for ADP and computing related procurements and contracts; directing the development of the annual NIH ADP Plan; representing the NIH in PHS and DHHS policy formulation efforts; working with GSA staff on procurements; coordinating Interagency Agreements with other Federal agencies that use DCRT facilities; and answering inquiries from scientists and administrators who are confused by the whole process.

Highlights of FY80 Activities

During the year this office reviewed nearly 500 proposals for procurement of ADP equipment and/or services in order to ensure that each was justified and in conformance with PHS, HHS, GSA, and OMB guidelines. In some cases suggestions were provided to the NIH Procurement Branch as to the most expeditious procurement route to follow. In many cases one or more of the Laboratories and Branches of DCRT provided expertise to help this office review technical aspects of the proposals.

A major highlight of the year was the complex reprocurement of the whole of the NIH general purpose central computing system. During the fifth year of this process a final competitive solicitation package was issued in January. Approximately 400 written questions were received from four potential vendors and were answered in writing with appropriate amendments to the solicitation package.

On the last day before proposals were due, a protest was filed. Dealing with the protest was a major effort for the remainder of the year.

Because of the protracted nature of the total reprocurement and the continued growth in user demands placed on the NIH Computer Center, it became necessary to ask for a temporary interim capacity upgrade pending completion of the total reprocurement. This action required NIH, PHS, HHS, and GSA approvals. The action was initiated on January 8 and sucessfully completed on June 20. Thirty-six individuals outside of DCRT had to approve of, or concur in, various aspects of the action—some, on several aspects.

Arrangements were completed by this office tc reassign the computer system replaced by this interim upgrade. It went to the National Library of Medicine. At the time of this writing arrangements were also being made for the 158 MP displaced from NLM to be reassigned to provide improvement to the processing power on which the Clinical Center's Medical Information System depends. Assistance was also provided to the Clinical Center to obtain approval for an extension of the present contract for the Hospital Information System and in preparing for a total reprocurement of that system.

In addition, total reprocurement of the DCRT Scientific Time Sharing system moved from the stage of a draft solicitation to a completed award.

This office provided assistance to the Division of Research Resources to develop an approach to upgrading the PROPHET System, the Chemical and Biological computing resource which serves NIH's grantee community. Assistance was provided to the Gerontology Research Center of the National Institute on Aging to develop specifications and later conduct a procurement for one system to serve as a data collection, data processing, and remote access interconnection with DCRT computers and for another system to replace the aging Raytheon 706 computer. Both were successfully completed as was a procurement for a major share of the equipment necessary for a new image processing system within DCRT.

As the year closed a major project to automate the NIH library was under way. This was a joint project by the Computer Systems Laboratory and Division Research Service staffs with assistance from this office for policy, clearance, and procurement aspects. Along the way the office carried out its usual annual assortment of other tasks including coordination and preparation of the Annual NIH ADP plan. This document combines projections of all NIH Bureaus, Institutes, Divisions, and Offices for ADP expenditures over the next four years as part of the NIH budget submission required by the Department and the Federal Office of Management and Budget.

Future Plans

Federal ADP policies and requirements continue to become more and more complex as OMB, GSA, DHHS, and PHS become more and more involved. As a result, the Office must spend an increasing portion of its available man-hours in attempting to guide NIH policy in productive directions and in meeting regulatory requirements. The Office will continue its work to spare large numbers of NIH research and research support staff members the task of becoming expert in the many nuances of ADP-related regulations.

Office of Administrative Management

L. Lee Manuel, Chief

Function

The Office of Administrative Management, under the direction of the Executive Officer, provides administrative, financial, and personnel management in support of the Division's programs. The office serves as liaison between these functions and the NIH Office of Administration, Office of Research Services and with other NIH, PHS, and DHHS offices.

Scope and Activities

The office handles a broad range of administrative managerial functions for an NIH research division of almost 300 people. The Financial Management/ Project Control Sections maintain 2000 project accounts involving 7200 registered users of the DCRT computer facilities and services; these services totalled an estimated $24,000,000 in FY 80. The Administrative Services Section processes requisitions, contracts, travel, and training documents; this variety of procurements totalled approximately $20,000,000 in FY80. Day-to-day activities also include managing personnel space, telephone charges, payroll, and other miscellaneous administrative subjects.

Highlights of FY80 Activities

The Personnel Section completed its mandated three year position classification review of all DCRT positions. It implemented the senior executive service and merit pay system at the DCRT. Evaluation criteria were implemented to cover appraisal of supervisors and managers at the GS-13 through GS-15 level for 31 merit pay employees.

The Financial Management Section was the primary focus for development and coordination of information for the DCRT portion of the NIH Forward Plan, Zero Based Budgetary Workload/Manpower reporting, and the standard Federal Budget process. Additional new requirements from the DHHS Secretary required intensive efforts by the Administrative staff in the areas of contracting, procurement, travel, and consultant services. Most of these requirements called for detailed plans to be prepared, mandated monthly and quarterly reporting requirements, and elevated certain delegations of authority to higher levels. All of these actions tended to increase the amount of "paperwork" required and further slowed the already cumbersome administrative processes. The DCRT Administrative Information Retrieval System (AIRS) was used to generate staffing charts this year from the plotting facility. This eliminated a lengthy typing chore for the staff and significantly reduced the cost of preparing these charts.

The Department conducted a systems security audit of the central facility and the Project Accounting System program. Preliminary comments show a few violations of a minor nature and the draft report has been received and commented on.

Future Plans

The major renovations of Building 12 and 12A will be completed in the coming year. These renovations will conclude the long-range plans developed several years ago and will allow for adequate physical security in the central computer complex. As further guidance on the new DHHS EEO program is received, new monitoring systems may have to be initiated to evaluate DCRT performance in this area. There undoubtedly will be new administrative managerial requirements and modifications of old ones forthcoming from the NIH, the PHS, the Department, the GSA, and the Civil Service Commission.

Office of Scientific and Technical Communications

William C. Mohler, M.D., Chief

Functions

The DCRT Office of Scientific and Technical Communications (OSTC), under the direction of the Associate Director, DCRT, includes:

- The DCRT **Library,** which maintains a collection in computer science and mathematics, statistics, engineering, information science, and management.
- The DCRT **Information Office,** which serves as the focus for providing the NIH community and the general public with information about DCRT's activities and their relationship to biomedical research.
- **Scientists** assigned to this office, working in related areas of pattern recognition, multidimensional information processing, and medical information science.

Scope of Activities

The DCRT Library is a small, independent, special library, staffed by the Librarian and a library technician. It performs the full range of library activities and has access to a wide variety of online information services and data bases. Its collection of monographs, periodicals, and other documents covers subjects related to the work of DCRT.

The Library supports the work of the DCRT staff and serves as a resource for employees in the rest of NIH. It is an integral part of the Washington area network of special libraries and cooperates with libraries outside the area to share resources. It does this through organizations such as the Interlibrary Users Association of the Washington Baltimore Area, The Metropolitan Washington Library Council, FEDLINK (a Federal library consortium) and at the national level, the OCLC network.

The DCRT Information Office, too, is small and handles the full range of activities of an NIH Information Office. The Information Officer, assisted by a Public Information Specialist, answers inquires, produces and distributes print and audiovisual materials, and arranges briefings and tours for visitors. They coordinate special events, work with members of the media and provide advice, assistance, and educational resources on communications for the DCRT staff. The office is responsible for all Freedom of Information requests coming to DCRT.

A significant part of the Information Office program is directed toward improving within the NIH understanding of the Division's work and the application of computing to biomedical research. But the scope of its communications includes Federal agencies, schools, libraries, private industry, medical organizations, and a wide variety of individual scientists and lay persons. The staff of the office is active in the NIH information community and Washington area associations of communication professionals.

The other professional activities of OSTC derive from the interests of its scientific professionals: a mathematician, a computer scientist, an information scientist, and a physician. They work with other professionals at NIH and with a wide variety of medical and technical groups, government and private, outside of NIH. They have research and development projects on biomedical data bases, image processing, and decision analysis.

Highlights of FY80

The DCRT Library completed development and installation of its automated circulation system. New report programs, written by the DCRT Data Management Branch, give a better overview of activity among books and borrowers. A new set of indices for the document collection now provides access by author and keywords in the document titles.

The Librarian worked with the DCRT Computer Systems Laboratory as consultant to the NIH Library to develop specifications for procurement of a new computer based system for its operations. She and the Chief of the Data Management Branch helped scientists from NIAMDD and NHLBI explore the options for acquiring their own computer based system for maintaining and searching files of citations to articles in the biomedical literature. She served as the Chairperson of the delegation from FEDLINK (the Federal Library Network) to the Users Council of OCLC, INC., a national cooperative library network.

The Library and the Division lost a valuable member when Ms. Jill Lindau accepted a position as a librarian at the Library of the Bureau of the Census. She began as a clerk in the DCRT Library, in the early 1970s, advanced to library technician and received her M.L.S. degree in 1979.

The Information Office made substantial progress on its program to complete a basic set of information documents about all DCRT activities. The effort to develop better ways to present this information included a major revision in the format of the Annual Report. New courses in Effective Technical Writing were added to the program begun by the office last year to help DCRT staff improve their communication skills.

The stream of requests and inquiries coming into the Information Office increased about 50 per cent this year. The audience for DCRT publications also increased, to a total of 4,800 items this year. Visitors getting briefings and tours ranged from a Montgomery County Girl Scout Troop to scientists from Australia, China, and the Soviet Union.

There were two dozen Freedom of Information requests, most from individuals connected with private computer organizations. A great deal of time went into handling this with administrative cost to the government over $1,500. DCRT sent the Department several suggestions to modify regulations to help recover some of these costs.

The Information Officer worked with DCRT scientists on a project to develop techniques for computer based preparation, editing, and typesetting of articles submitted to scientific journals. She served on the NIH Information Officers Training Committee, was active in the National Association of Government Communicators, and was elected president of the Washington chapter of Women in Communications, Inc., a national organization for public relations, journalism, broadcasting, and communications professionals.

Dr. Judith M. S. Prewitt continued her collaboration with Dr. B. R. Hunt at the University of Arizona in a study group sponsored by the Office of Naval Research and the National Science Foundation to formulate the automation of image processing. She developed a new collaboration with Dr. K. S. Fu, Purdue University, on Pattern Recognition and Image Processing and on Parallel Algorithms and Computer Architecture. As principle investigator, she began a project sponsored by the Goddard Space Flight Center, NASA, to evaluate the utility of the NASA/ Goddard Massively Parallel Processor for biomedical applications.

The scope of Dr. Prewitt's other work is indicated by the publications listed at the end of this section. Dr. Sanjay Ranade joined her during the last half of the year as an NIH Staff Fellow to develop and apply algorithms for the processing of cellular and tissue images, including a new project on the analysis of muscle in collaboration with Dr. Robert Burke, NINCDS.

Mr. Martin Epstein provided technical advice and counsel to the Lister Hill Center, NLM, for its medical knowledge base program, and in the Spring he accepted an appointment as Assistant to the Director of the Center. He finished his doctoral dissertation for the University of California, San Francisco, on Natural Language Access to Clinical Data Bases. His MEDINQUIRY system is the cornerstone of a collaborative project with investigators at UCSF, The University of Pennsylvania, and SRI International to develop and use enlarged data bases covering patients with malignant melanoma.

The Computers in Clinical Medicine course for medical students was again organized by Dr. William C. Mohler, under the NIH Clinical Elective Program. Dr. Mohler continued to work with the NIH Clinical Center to apply the DCRT Clinical Information Utility to patient care and clinical research.

Plans

Plans for the coming year will follow the lines set in FY80 and previous years.

The Library will try to cope with two changes that have formidable consequences for all libraries: A new edition of the *Anglo American Cataloging Rules* (AACR2) will be implemented in 1981 and the Library of Congress will shift to an online catalog. Some form of automated catalog system will be necessary for libraries to keep up with these changes. At NIH, the DCRT and the NIEHS libraries are too small to initiate separate efforts to develop this kind of system. The DCRT and NIEHS librarians have met with the NIH Library staff to explore a cooperative effort based on the NIH Library contracts for library automation systems.

The Information Office will continue to develop and improve materials to tell people what DCRT does and how computers are used in biomedical research. This will include some new audiovisual packages for use at NIH and perhaps for export in response to requests from outside NIH. The Information Office will survey both the DCRT and the NIH to bring up to date the list of needs for communications about computers at NIH.

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